

## **11.5 Computer Codes**

Many computer software programs have been developed for calculating stress intensity factors, often as part of a life assessment software. Some of these software programs are listed here.

### **11.5.1 NASGRO Fracture Analysis Software**

NASGRO Fracture Analysis Software is a suite of programs based on fracture mechanics principles. NASGRO can be used to analyze crack growth, perform assessments of structural life, compute stresses, and process and store fatigue crack growth properties. The package includes a large set of crack growth rate and fracture data.

NASGRO was originally developed at NASA Johnson Space Center to perform fracture control analysis on NASA space systems. Later, after the NASA/FAA/USAF Aging Aircraft Program was formed and began supporting the development effort, NASGRO was developed further for use in damage tolerance analysis of aircraft, including that required for FAA certification.

The software is comprised of the following three modules:

- NASFLA - Life Assessment
- NASBEM - 2-D Boundary Element
- NASMAT - Database of  $da/dN$  & fracture test results

NASFLA is part of the NASGRO 3.0 suite of programs Stress Intensity Factor -These are computed for the crack geometry and loading chosen from the NASFLA library of models, and displayed in tabular or graphical form.

NASBEM is part of the NASGRO 3.0 suite of programs. It is a two-dimensional boundary element program used to perform the following analyses:

- Stress Intensity Factors - These can be calculated for any geometry and loading. Tables of stress intensity factors and corresponding crack lengths can be generated for use by the NASFLA module in performing life assessments.
- Stress Fields - These can be calculated for any collection of points in the two-dimensional uncracked object being modeled including its boundary.

NASMAT is used to store, retrieve and curve fit crack growth and fracture toughness data. It has a database containing over 9000 sets of data. This includes over 3000 sets of fatigue crack growth data and over 6000 fracture toughness data points. These data can be searched, plotted, and fitted to either the NASGRO crack growth rate equation or a user specified growth rate equation, or they can be entered into a growth rate table.

### **11.5.2 AFGROW Fracture Analysis Software**

AFGROW Fracture Analysis Software is a suite of programs based on fracture mechanics

### **11.5.3 Cracks2000 Structural Integrity Software**

The CRACKS2000 program is based on the Linear Elastic Fracture Mechanics (LEFM) approach for estimating the fatigue life of a component with a crack. The LEFM approach uses the stress intensity factor parameter, as the driving factor for crack growth. The Cracks2000

program has considerable flexibility in the analytical modeling of crack growth analysis problems.

Cracks2000 has fifty-one stress intensity factors solutions. There are closed form equations for stress intensity factor solutions for 25 geometries. Many of these solutions are the early Newman-Raju solutions, which are retained for comparisons with older analysis. For the latest stress intensity factor solutions, tables of  $\beta$ -factors are generated from the equations; the tables are used for the life analysis, and can be printed and plotted for  $\beta$ -factors comparison

Additional information on the Cracks2000 software can be found at:

<http://www.udri.udayton.edu/cracks/>

or contact

Ms. Peggy C. Miedlar  
University of Dayton Research Institute  
300 College Park  
Dayton, Ohio 45469-0120  
Phone: (937) 229-4417  
email: [miedlar@udri.udayton.edu](mailto:miedlar@udri.udayton.edu)